

It has an X-ray diffraction half width of 500 seconds or less in at least one of a {20-24} diffraction plane and a {11-24} diffraction plane.

These aspects of the present invention were first reached by the present Inventor.

Further, the present invention clarifies the relationship between the X-ray diffraction half width of both planes of a self-supported GaN substrate and the emission power of an LED produced using the self-supported GaN substrate. See Tables 2 and 3 of the present specification.

The Prior Art

"Dislocation Reduction in AlN and GaN Bulk Crystals grown by HVPE" to Albrecht et al (Albrecht); U.S. 6,936,357 Melnik et al (Melnik).

The Rejection

Claims 1, 2 and 8, all claims under examination, are rejected as obvious over Albrecht in view of Melnik.

Applicant respectfully traverses for the reasons now advanced.

Traversal

At page 2 of the Action, just under the first full paragraph after the formal paragraphs, the Examiner states:

"Regarding claim 1 Albrecht et al. teach GaN and AlN crystals grown by hybrid vapor phase epitaxy (HVPE) to thicknesses of 100-200 microns (Albrecht et al., pg 453, last line)."

The Examiner is submitted to be in error in this interpretation of Albrecht.

If the Examiner will refer to Albrecht at pages 454, last five lines in section 2.1 Sample Growth, the following disclosure occurs (bolding added):

"The SiC substrates were removed by reactive ion etching (RIE) in a SF₆ containing gas mixture to obtain free standing bulk GaN crystals (maximum size of 7 x 6 x 0.1 mm³). Fracture of the

layers was the main factor limiting the size of these bulk crystals. The responsible strains result from the lattice mismatch and different thermal expansion coefficients of GaN and SiC."

What this means is that it is, simply stated, impossible for Albrecht to obtain a free standing bulk GaN crystal having a diameter of 10 mm or more. Applicant respectfully submits that nothing of record establishes that one of ordinary skill in the art would conclude that control or regulation of diameter dimensions could be easily established as long as HVPE growth were to be performed. As a consequence, and as reflected in Albrecht, it is not a simple matter to produce free standing bulk GaN crystals having a large diameter dimension, even with HVPE growth.

With respect to Melnik et al, towards the bottom of page 2 of the Action, the Examiner reads Melnik et al as follows:

"Melnik et al. teach that the nitride substrate crystals will have a minimum dimension of 1 cm in the x, y, and z directions. Thus showing a crystal with a diameter of 10 mm (1 cm) or more (Melnik et al., col. 3, lines 10-17)."

Applicant submits this to be an overly broad interpretation of Melnik.

Specifically, although Melnik discloses bulk GaN and AlGaN single crystal boules having a volume in excess of 4 cubic centimeters with a minimum dimension (i.e., x, y, or z dimension) of approximately 1 cm using a modified HVPE process (col. 3, lines 10-17 of Melnik), Melnik fails to teach an X-ray diffraction half width of 500 seconds or less in at least one of a {20-24} diffraction plane and a {11-24} diffraction plane.

Thus, Melnik does not direct one of ordinary skill in the art to the features in claim 1 herein defining the X-ray diffraction half width recited in claim 1. More specifically, given the defect in Albrecht earlier discussed, there is no reason why one of ordinary skill in the art would

reasonably expect that using the Melnik procedure one could obtain the combination of the X-ray diffraction half width of 500 seconds or less and a free standing GaN crystal as being a diameter of 10 mm or more as claimed.

With respect to Albrecht, single crystalline GaN substrates merely having an X-ray diffraction half width as in Albrecht which can be obtained in a short time with a size not reaching 10 mm have few industrial benefits and are not put to practical use, according to the Inventor herein.

On the other hand, the self-supported nitride semiconductor substrate of the present invention has a large enough size so that the same is extremely useful in industry and the emission power of an LED is dramatically improved in the case where an LED structure having the X-ray diffraction half width as claimed is grown. The Examiner's attention is directed to Tables 2 and 3.

Request for Withdrawal of Finality of Action

At page 4 of the Action, bottom of the page, the Examiner states:

"The applicants amended the instant claims to include the limitation of thickness to overcome the prior art of record. Jagenathan et al. teach that the wafer is of a thickness in the sub micron range, therefore a thickness of 50 microns (several orders larger than the prior art) is not anticipated nor deemed obvious. The rejections over Jagenathan et al. have been removed.

However, this is not the complete picture of the basis for rejection.

Applicant did not amend claim 1 or claim 8 with respect to the X-ray diffraction half width of 500 seconds or less in at least one of the {20-24} diffraction plane and a {11-24} diffraction plane nor did Applicant amend at the point of a diameter of 10 mm or more.

RESPONSE/REQUEST FOR WITHDRAWAL
OF FINALITY OF ACTION

Attorney Docket No.: Q80989
Application No.: 10/821,957

However, to support the rejection, the Examiner newly cites Albrecht which goes to limitations which were present prior to the last amendments to the claims, namely thickness and the X-ray diffraction half width limitation of claims 1 (and 8).

Accordingly, what the Examiner has done is essentially presented a totally new rejection over claim limits which were present prior to adding the limitation on the thickness.


It is respectfully submitted that in this case, where the Examiner must cite new prior art due to a defect in the original prior art (in this case, regarding the X-ray diffraction half width of 500 seconds or less, which was claimed prior to the present action), the rejection is improperly made final and should be withdrawn.

Such is requested.

The Examiner is requested to contact the undersigned regarding the finality of the Action at the later given local telephone exchange.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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